[Document Name] Claims

[Claim 1]

An information recording method of recording information by forming recording marks by emitting light, from a light source on a record medium, modulated according to record information and rules by use of n (n: integer more than one) type data length sets which are classified by a data length of record information such that the rules of recording waveforms thereof are different, comprising:

a first trial write step of writing as a trial a predetermined first test pattern in a trial write area of the record medium while changing a recording power for emitting in a stepwise manner, so as to obtain an optimum recording power from a reproduced signal of recorded trial write data; and

a second trial write step of performing trial write in the trial write area of the record medium by use of the optimum recording power by using a second test pattern corresponding to each of the data length sets while changing pulse width or pulse edge position of recording waveform for each of the data length sets in a stepwise manner, and obtaining an optimum pulse width or optimum pulse

edge position of the recording waveform corresponding to each of the data length sets from a reproduced signal of each recorded second test pattern,

wherein information is recorded based on the optimum recording power obtained in said first trial write step and the optimum pulse width or optimum pulse edge position obtained in the second trial write step.

[Claim 2]

The information recording method as claimed in claim 1, wherein said first trial write step includes:

a first test pattern generating step of generating the first test pattern for performing trial write in the trial write area of the record medium; and

an optimum recording power obtaining step of obtaining the optimum recording power from the reproduced signal of the recorded trial write data,

and wherein said second trial write step includes:

a second test pattern generating step of generating the second test pattern corresponding to

each of the data length sets for performing of trial write;

a trial write processing step of performing trial write in the trial write area of the record medium by using the optimum recording power and the second test pattern while maintaining fixed pulse width and fixed pulse edge position of recording waveform for one or more particular data length sets and while changing pulse width or pulse edge position of recording waveform for other data length sets in a stepwise manner; and

an optimum recording waveform obtaining step of obtaining the optimum pulse width or optimum pulse edge position of recording waveform corresponding to the data length sets from the reproduced signal of the second test pattern corresponding to said other data length sets by using a reference asymmetry value derived from a reproduced signal of recorded trial write data corresponding to the second test pattern corresponding to said one or more particular data sets.

[Claim 3]

The information recording method as

claimed in claim 1 or 2, wherein the first test pattern is a data series including all data lengths, and wherein the second test pattern has a predetermined data length, and is a data series that constitutes the n type data length sets.

[Claim 4]

The information recording method as claimed in claim 1, wherein the optimum recording power in said first trial write step is obtained from a modulation factor of the reproduced signal of the area in which trial write is performed in said step, or obtained from a rate of change in the modulation factor, and wherein the optimum pulse width or optimum pulse edge position corresponding to each of the data length sets in said second trial write step is obtained from an asymmetry that is a ratio of a positive-side peak value to a negative-side peak value relative to an average value level of the reproduced signal of the area in which trial write is performed in said step.

[Claim 5]

The information recording method as claimed in claim 2, wherein the optimum recording

power in said first trial write step is obtained such that a modulation factor, or a rate of change in the modulation factor, of the reproduced signal of the area in which trial write is performed in said step becomes a desired value, and wherein the optimum pulse width or optimum pulse edge position corresponding to each of said other data length sets in said second trial write step is obtained such that an asymmetry of the reproduced signal of the area in which trial write is performed in said step substantially coincides with a value of an asymmetry corresponding to said one or more particular data length sets.

[Claim 6]

The information recording method as claimed in claim 5, wherein the optimum pulse width or optimum pulse edge position corresponding to each of the data length sets in said second trial write step is obtained from an average value of the reproduced signal corresponding to each of the n type data length sets in the area in which trial write is performed in said step.

[Claim 7]

An information recording method of recording information by forming recording marks by emitting light, from a light source on a record medium, modulated according to record information and rules by use of n (n: integer more than one) type data length sets which are classified by a data length of record information such that the rules of recording waveforms thereof are different, comprising:

a trial write step, provided separately for each of the data length sets, of performing trial write in a trial write area of the record medium by use of the optimum recording power by using a test pattern corresponding to each of the data length sets while changing pulse width or pulse edge position of recording waveform for each of the data length sets in a stepwise manner, and obtaining an optimum pulse width or optimum pulse edge position of the recording waveform corresponding to each of the data length sets from a reproduced signal of each recorded second test pattern,

wherein information is recorded based on the optimum pulse width or optimum pulse edge position obtained in each trial write step.

[Claim 8]

The information recording method as claimed in claim 1 or 7, wherein the data length sets are classified according to a remainder of division of the data length of the record information by the integer n, and the data length sets have, as a data length corresponding to a clock cycle T of the record information, a rule by which a pair of a heating pulse and a cooling pulse is added for each nT multi-pulses constituting the record waveform of the n type data length sets.

[Claim 9]

The information recording method as claimed in claim 2 or 5, wherein the integer n is 2, and a pair of a heating pulse and a cooling pulse is added for every 2T multi-pulses constituting the record waveform of each of the data length sets, and wherein the data length sets having odd-number-length data lengths with respect to a clock cycle T of the record information are used as said particular data length sets.

[Claim 10]

An information recording apparatus for

recording information by forming recording marks by emitting light, from a light source on a record medium, modulated according to record information and rules by use of n (n: integer more than one) type data length sets which are classified by a data length of record information such that the rules of recording waveforms thereof are different, comprising:

a first trial write unit to write as a trial a predetermined first test pattern in a trial write area of the record medium while changing a recording power for emitting in a stepwise manner, so as to obtain an optimum recording power from a reproduced signal of recorded trial write data; and

a second trial write unit to perform trial write in the trial write area of the record medium by use of the optimum recording power by using a second test pattern corresponding to each of the data length sets while changing pulse width or pulse edge position of recording waveform for each of the data length sets in a stepwise manner, and obtaining an optimum pulse width or optimum pulse edge position of the recording waveform corresponding to each of the data length sets from a reproduced signal of each recorded second test pattern,

wherein information is recorded based on the optimum recording power obtained by said first trial write unit and the optimum pulse width or optimum pulse edge position obtained by the second trial write unit.

[Claim 11]

The information recording apparatus as claimed in claim 10, wherein said first trial write unit includes:

a first test pattern generating unit to generate the first test pattern for performing trial write in the trial write area of the record medium; and

an optimum recording power obtaining unit to obtain the optimum recording power from the reproduced signal of the recorded trial write data,

and wherein said second trial write unit includes:

a second test pattern generating unit to generate the second test pattern corresponding to each of the data length sets for performing of trial write;

a trial write processing unit to perform trial write in the trial write area of the record

medium by using the optimum recording power and the second test pattern while maintaining fixed pulse width and fixed pulse edge position of recording waveform for one or more particular data length sets and while changing pulse width or pulse edge position of recording waveform for other data length sets in a stepwise manner; and

an optimum recording waveform obtaining unit to obtain the optimum pulse width or optimum pulse edge position of recording waveform corresponding to the data length sets from the reproduced signal of the second test pattern corresponding to said other data length sets by using a reference asymmetry value derived from a reproduced signal of recorded trial write data corresponding to the second test pattern corresponding to said one or more particular data sets.

[Claim 12]

The information recording apparatus as claimed in claim 10 or 11, wherein the first test pattern is a data series including all data lengths, and wherein the second test pattern has a predetermined data length, and is a data series that

constitutes the n type data length sets.

[Claim 13]

The information recording method as claimed in claim 10, wherein the optimum recording power in said first trial write unit is obtained from a modulation factor of the reproduced signal of the area in which trial write is performed in said unit, or obtained from a rate of change in the modulation factor, and wherein the optimum pulse width or optimum pulse edge position corresponding to each of the data length sets in said second trial write unit is obtained from an asymmetry that is a ratio of a positive-side peak value to a negative-side peak value relative to an average value level of the reproduced signal of the area in which trial write is performed in said unit.

[Claim 14]

The information recording apparatus as claimed in claim 11, wherein the optimum recording power in said first trial write unit is obtained such that a modulation factor, or a rate of change in the modulation factor, of the reproduced signal of the area in which trial write is performed in

said unit becomes a desired value, and wherein the optimum pulse width or optimum pulse edge position corresponding to each of said other data length sets in said second trial write unit is obtained such that an asymmetry of the reproduced signal of the area in which trial write is performed in said unit substantially coincides with a value of an asymmetry corresponding to said one or more particular data length sets.

[Claim 15]

The information recording apparatus as claimed in apparatus 14, wherein the optimum pulse width or optimum pulse edge position corresponding to each of the data length sets in said second trial write unit is obtained from an average value of the reproduced signal corresponding to each of the n type data length sets in the area in which trial write is performed in said unit.

[Claim 16]

An information recording apparatus for recording information by forming recording marks by emitting light, from a light source on a record medium, modulated according to record information

and rules by use of n (n: integer more than one) type data length sets which are classified by a data length of record information such that the rules of recording waveforms thereof are different, comprising:

a trial write unit, provided separately for each of the data length sets, to perform trial write in a trial write area of the record medium by use of the optimum recording power by using a test pattern corresponding to each of the data length sets while changing pulse width or pulse edge position of recording waveform for each of the data length sets in a stepwise manner, and to obtain an optimum pulse width or optimum pulse edge position of the recording waveform corresponding to each of the data length sets from a reproduced signal of each recorded second test pattern,

wherein information is recorded based on the optimum pulse width or optimum pulse edge position obtained by each trial write unit.

[Claim 17]

The information recording apparatus as claimed in claim 10 or 16, wherein the data length sets are classified according to a remainder of

division of the data length of the record information by the integer n, and the data length sets have, as a data length corresponding to a clock cycle T of the record information, a rule by which a pair of a heating pulse and a cooling pulse is added for each nT multi-pulses constituting the record waveform of the n type data length sets.

[Claim 18]

The information recording apparatus as claimed in claim 11 or 14, wherein the integer n is 2, and a pair of a heating pulse and a cooling pulse is added for every 2T multi-pulses constituting the record waveform of each of the data length sets, and wherein the data length sets having odd-number-length data lengths with respect to a clock cycle T of the record information are used as said particular data length sets.

[Claim 19]

A record medium having an information recording program recorded therein for causing a controller to record information by forming recording marks by emitting light, from a light source on a record medium, modulated according to

record information and rules by use of n (n: integer more than one) type data length sets which are classified by a data length of record information such that the rules of recording waveforms thereof are different, said information recording program causing said controller to perform:

a first trial write step of writing as a trial a predetermined first test pattern in a trial write area of the record medium while changing a recording power for emitting in a stepwise manner, so as to obtain an optimum recording power from a reproduced signal of recorded trial write data; and

a second trial write step of performing trial write in the trial write area of the record medium by use of the optimum recording power by using a second test pattern corresponding to each of the data length sets while changing pulse width or pulse edge position of recording waveform for each of the data length sets in a stepwise manner, and obtaining an optimum pulse width or optimum pulse edge position of the recording waveform corresponding to each of the data length sets from a reproduced signal of each recorded second test pattern,

wherein said controller is caused by said

information recording program to record information based on the optimum recording power obtained in said first trial write step and the optimum pulse width or optimum pulse edge position obtained in the second trial write step.

[Claim 20]

The record medium having the information recording program recorded therein as claimed in claim 19, wherein said first trial write step of said information recording program causes said controller to perform:

a first test pattern generating step of generating the first test pattern for performing trial write in the trial write area of the record medium; and

an optimum recording power obtaining step of obtaining the optimum recording power from the reproduced signal of the recorded trial write data,

and wherein said second trial write step of said information recording program causes said controller to perform:

a second test pattern generating step of generating the second test pattern corresponding to each of the data length sets for performing of trial

write;

a trial write processing step of performing trial write in the trial write area of the record medium by using the optimum recording power and the second test pattern while maintaining fixed pulse width and fixed pulse edge position of recording waveform for one or more particular data length sets and while changing pulse width or pulse edge position of recording waveform for other data length sets in a stepwise manner; and

an optimum recording waveform obtaining step of obtaining the optimum pulse width or optimum pulse edge position of recording waveform corresponding to the data length sets from the reproduced signal of the second test pattern corresponding to said other data length sets by using a reference asymmetry value derived from a reproduced signal of recorded trial write data corresponding to the second test pattern corresponding to said one or more particular data sets.

[Document Name] Abstract

[Problem to be Solved]

Accurate recording is achieved by obtaining each optimum pulse width and pulse edge position in a recording method that performs recording according to the rules of recording waveform using different pulse widths and pulse edge positions for individual data length sets with respect to the data length sets having the different relationship between the number of pulses and the data length.

[Means for Solving the Problem]

The first trial write process obtains an optimum recording power of a test pattern (S1 through S3) even with respect to data having different rules for the recording waveforms corresponding n type data length sets, and the second trial write process using this optimum recording power obtains optimum pulse width or optimum pulse edge position separately for each data length set (S4 through S6). Based on the optimum recording power and optimum recording waveform obtained by these trial write processes, recording operation is performed so as to form all the data lengths with satisfactory accuracy, thereby making it possible to obtain a proper reproduced signal.